AFOEHL REPORT 90-141EQ00086GDA

PTPLU Dispersion Modeling of the Proposed Waste-Oil Boiler, Hill AFB UT

PAUL T. SCOTT, Capt, USAF

AUGUST 1990

Final Report

AF Occupational and Environmental Health Laboratory (AFSC)
Human Systems Division
Brooks Air Force Base, Texas 78235-5501

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No 0704 0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	July 1990	Final

4. TITLE AND SUBTITLE
PTPLU Dispersion Modeling of The Proposed Waste-Oil Boiler, Hill AFB

5. FUNDING NUMBERS

6. AUTHOR(S)
Paul T. Scott, Capt, USAF, BSC

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
AF Occupational and Environmental Health Laboratory
Brooks AFB TX 78235-5501

8. PERFORMING ORGANIZATION REPORT NUMBER
AFOEHL Report
90-141 EQ00086GDA

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Same as Blk 7

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Statement A. Unlimited, approved for public release

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

HQ Ogden ALC/MAQV requested AFOEHL/EQE conduct the dispersion modeling for their proposed waste-oil fired boiler permit application in accordance with the directions of the Utah State Department of Health, Air Quality Division. The state requested PTPLU from the Environmental Protection Agency's (EPA) UNAMAP series as the dispersion model. This report discusses the potential for lead and sulfer dioxide emissions from the proposed boiler, and the probable impact to housing areas west of the proposed boiler site. Results indicated that no impact exists under most circumstances; however, suspension of operation or clean fuel substitution should be considered under severe winter air stagnation conditions.

14. SUBJECT TERMS					15. NUMBER OF PAGES
Dispersion Modeling	PTPLU	Lead	Hill	Scott	39
Air Quality	Sulfur dioxide				16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	none

NSN 7540-01-280-5500
Standard Form 298 (Rev 2-89)
Prescribed by ANSI Std Z39-18
298-102

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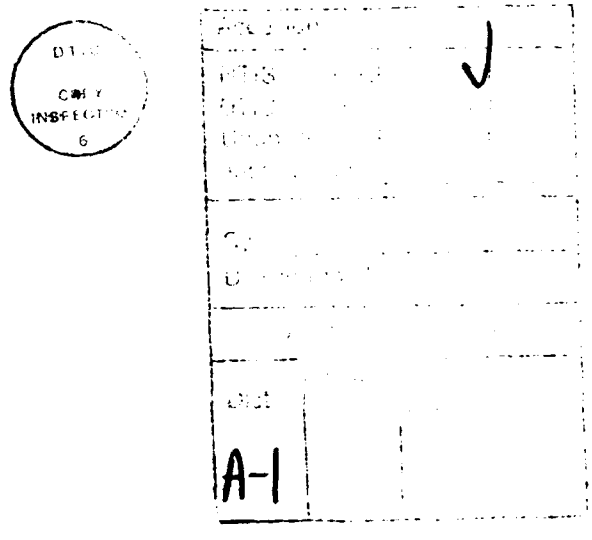

I. INTRODUCTION

HQ Ogden ALC/MAQV requested AFOEHL/EQE (Appendix A) conduct the dispersion modeling for their proposed waste-oil fired boiler in accordance with the directions of the Utah State Department of Health, Air Quality Division. The state requested PTPLU from the Environmental Protection Agency's (EPA) UNAMAP series as the dispersion model. This report discusses the potential for the emissions from this proposed boiler to impact housing areas to the west of the proposed boiler site. Personnel involved in this study are listed in Appendix B.

II. DISCUSSION

A. Background

Waste oil generated at Hill AFB was previously discarded via contractor. In an effort to employ waste minimization, a boiler was proposed to utilize the waste oil to satisfy some of the energy requirements of Hill AFB. Since the base waste oil contains sulfur (emitted as sulfer dioxide (SO_2) and heavy metals including lead (Pb), chromium (Cr), cadmium (Cd), and barium (Ba); ambient air quality at nearby housing areas were a concern to state and Hill AFB personnel. PTPLU, a screening model in EPA's UNAMAP series was recommended by the State Health Department as an appropriate model to determine ambient emission levels from the proposed boiler.

B. Site Description

The proposed boiler will be located in a remote region on the western perimeter of the base. Housing areas are located approximately 500 meters (m) west of the site. Base facilities are located about 1 kilometer (km) south of the site. The proposed boiler has a capacity of 155 gal/hr with the waste oil rated at 19000 BTU/lb (133 BTU/gal). It will operate at 80% in winter and 10% in summer. The top of the stack is 9.144 m above ground at an elevation of 4603 ft MSL. The elevation drops off quickly to the west with the housing area being about 80 ft below the elevation of the boiler site. The elevation rises slightly to the east of the boiler with little change to either the north or the south.

C. Applicable Standards

There are no applicable ambient air quality standards for barium, cadmium, and chromium. Particulate standards are in term of 10 micron sized particles and that differentiation of the particulate emissions was not available for this study. The applicable ambient air quality standards that applies for this scenario are the National primary standards (40 CFR 50.4 and 50.12) for sulfur and lead as follows:

Lead	1.5 $\mu g/m^3$	Maximum arithmetic mean averaged one quarter year
SO_2	80 $\mu g/m^3$	Maximum annual arithmetic Mean
	365 $\mu g/m^3$	24 hr max avg concentration not to be exceeded more than once per year
	1.3 mg/m^3	3 hr max avg concentration not to be exceeded more than once per year

D. Model Description

PTPLU-2.0 is an air quality dispersion model in version 6 of UNAMAP. It is a screening model designed to estimate the maximum short term concentration from a single point source as a function of atmospheric stability and wind speed. The model uses a Gaussian algorithm with options for gradual plume rise, bouyancy-induced dispersion, and stack downwash. Buoyancy-induced dispersion and stack downwash options are selected for these model runs. Maximum concentrations and their corresponding downwind distances are computed for two sets of wind speeds: winds constant with height and winds increasing with height. Pasquill-Gifford dispersion (rural) coefficients and stability classes are utilized. Short comings of the model, especially in this application, are fumigation and terrain effects neither of which are considered. Model results should be looked at in light of these two parameters. The pollutant emission rates used in this model, were supplied by Hill AFB via waste oil analysis. Geographical and Meteorological Data are presented in Appendix C.

E. Results

PTPLU was run with EPA recommended meteorological conditions and the model applied according to EPA options and guidelines. Under these guidelines, the mixing height is set at 1500 m, and the worst conditions under the applicable stability classes, using extrapolated winds, are then doubled to represent a worst case condition. The worst case condition is done in this way since PTPLU does not handle a low ceiling or fumigation scenario properly. Table 1 gives the maximum ground level concentrations and the complete model run is in Appendix D. It can be seen that the maximum lead concentration is almost double the National primary standard. Also, the SO_2 concentration is above the maximum annual standard. However, this assumes the boiler would be operating at 100%, 100% of the time. With the boiler operating at 80% for 8 months and 10% for 4 months, the annual mean SO_2 concentration would not exceed the annual mean standard. In addition, worst conditions would not persist long enough to even make SO_2 concentrations a potential threat. SO_2 concentrations are well below 24 and 3 hr maximum average concentration standards. For the boiler's operating schedule, lead would still exceed ambient standards under these worst case meteorological conditions.

These worst case conditions are also indicative of certain weather conditions such as high pressure setting over the entire intermountain west with light or calm winds. The strong subsidence effect which results would trap most pollutants near the surface. Local wind (i.e., small scale) effects, such as channeling, could complicate the direction of the pollutant's dispersion even under light winds. Normally, wind direction will have little influence under these conditions. Also, receptor concentrations would increase with time as long as the conditions persisted. Maximum concentrations in Table 1 do not reflect these long term concentration levels. Emission rates for the model were provided by Hill AFB.

Table 1. Maximum Concentrations from PTPLU Worst Case Meteorological Conditions

Pollutant	Emission Rate (g/sec)	Max concentration at receptor height ($\mu g/m^3$)	Distance to Max Concentration (Km)
Barium	3.279E-4	6.648E-2	0.132
Cadmium	4.918E-4	9.970E-2	0.132
Chromium	4.288E-4	8.692E-2	0.132
Lead	1.400E-2	2.838	0.132
Particulates	2.054	416.4	0.132
SO_2	6.830E-1	138.5	0.132

PTPLU was also analyzed for average weather conditions in the Hill AFB area. This is the same data set (Appendix D), but the concentrations are not doubled to reflect worst case, rather the average case. Table 2 gives maximum concentrations which occur under neutral meteorological conditions, i.e., stability class 3 in the model output (Pasquill stability class C). West winds at 7 m/sec would give stronger maximum concentrations than indicated in Table 2 because of the damming effect that occurs due to upslope conditions. East and east-southeast winds which occur approximately 16-20% of the time would most immediately effect the housing areas to the west. With the actual 80% winter operating schedule, no significant ambient concentrations would exist during average meteorological conditions. However, lead concentrations are high enough to warrant concern.

Table 2. Maximum Concentrations for Run 2 from PTPLU Normal Meteorological Conditions

Pollutant	Emission Rate (g/sec)	Wind Speed (m/sec)	Max concentration at receptor height ($\mu g/m^3$)	Distance to Max Concentration (Km)
Barium	3.279E-4	6.94	3.324E-2	0.132
Cadmium	4.918E-4	6.94	4.985E-2	0.132
Chromium	4.288E-4	6.94	4.346E-2	0.132
Lead	1.400E-2	6.94	1.419	0.132
Particulates	2.054	6.94	208.2	0.132
SO_2	6.830E-1	6.94	69.23	0.132

III. CONCLUSIONS

Both PTPLU model runs show insignificant ambient concentrations of particulates, cadmium, barium, and chromium when the boiler is operating at 100% capacity. Sulfur dioxide concentrations are also below the National ambient air quality standards under normal meteorological conditions. Since the boiler will only be operating at 80% in winter, this reduces emissions even further. However, lead concentrations will exceed National ambient quality standards during strong subsidence conditions in winter. Also, under severe winter air stagnation conditions, insignificant concentrations can grow

to become a serious concern. Even the worst case scenario does not accurately reflect the fumugation process that develops after four or more weeks of strong subsidence. In contrast, summer unstable conditions and a 10% operating level will mean inconsequential ambient pollutant concentrations from Hill AFB's waste-oil boiler.

IV. RECOMMENDATIONS

An alternative to waste oil should be chosen as a boiler fuel during severe air stagnation conditions and a waste oil mix should be used for other winter conditions. For all other operating conditions 100% waste oil should be considered. AFOEHL will remain active for your modeling or source emission testing requirements.

References

1. Code of Federal Regulations. Vol 40, Part 50, The Office of the Federal Register, National Archives and Records Service, General Services Administration, Washington DC, July 1988.

2. PTPLU-A Single Source Gaussian Dispersion Algorithm. United States Environmental Protection Agency, Research Triangle Park, North Carolina, Aug 1982.

3. Addendum to PTPLU-A Single Source Gaussian Dispersion Algorithm. United States Environmental Protection Agency, Research Triangle Park, North Carolina, Dec 1986.

4. Guideline On Air Quality Models (Revised). United States Environmental Protection Agency, Research Triangle Park, North Carolina, July 1986.

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Appendix A
Request Letter

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS OGDEN AIR LOGISTICS CENTER (AFLC)
HILL AIR FORCE BASE, UTAH 84056-5149

REPLY TO ATTN OF MAQV

28 November 1989

SUBJECT Waste Oil Boiler Emissions Modeling

TO SGB

1. We are working with the Directorate of Environmental Management (EM) and the Civil Engineering Division (DE) to design and procure a boiler for burning the waste oil generated here at Hill AFB. Preliminary discussion with the State Department of Health revealed stack gas emissions should be checked with an approved computer model. We understand the Occupational Environmental Health Lab, Air Quality Division (AFOEHL/EQE) at Brooks AFB, TX, has several air emission models including UNAMAP/PTPLU. Because the State Department of Health would like us to use PTPLU from the UNAMAP series, we request your office contact AFOEHL/EQE and have them model the waste oil boiler's emissions.

2. Tabulated below are the data necessary to run a PTPLU emissions model.

Stack Height	30 ft - 9.144 m
Bldg Height	20 ft - 6.096 m
Stack Diameter	28 inch - 0.711 m = 2.33 ft
Stack Gas Temp	450° F - 505°K
Stack Gas Vol	242,500 scfh @ 100% capacity
Summer Operation	11% capacity
Winter Operation	80% capacity
Metals Emissions:	Ba .0026 lb/hr = 3.2789×10^{-4}
	Cd .0039 lb/hr = 4.9183×10^{-4}
	Cr .0034 lb/hr = 4.2878×10^{-4}
	Pb .111 lb/hr = 1.400×10^{-2}

Attached is a map showing the boiler's location on base. Directly west of Highway 91, and the boiler site is a housing development not shown on the map. Also attached are two drawings showing the stack location and building dimensions.

$\frac{242500\ ft^3}{hr} \quad \frac{\text{Volume}}{\text{Area}} / hr = \text{Area}(ft^2)/hr^2$

$\frac{242500\ ft^3}{\pi (1.166)^2} \times \frac{1\ hr}{3600\ s} \times \frac{12\ in}{ft} \times \frac{m}{39.3\ in} = FPS = 19.21\ m/s$ 4.80

3. Point of contact is John Vidic, MAQVE, extension 70816.

Thomas M Pazell

THOMAS M. PAZELL
Actg Ch, Environ & Ind Safety Br
Prod Qlty & Reliability Division

3 Atch
1. Base Map
2. Top View of Boiler
3. Elevation of Boiler

cc: EMR (Capt Heyse)
EME (Gupta)
DEEOC (Pollard)

APPENDIX B
PERSONNEL

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Personnel

1. AFOEHL

   Capt Paul T. Scott, Chief, Air Quality Function

   AFOEHL/EQE
   Brooks AFB TX 78235-5501
   AV 240-2891
   COM (512)536-2891

2. Hill AFB

   John Vidic — Ogden ALC/MAQVE
   AV 458-0816

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APPENDIX C
Geographical and Meteorological Data

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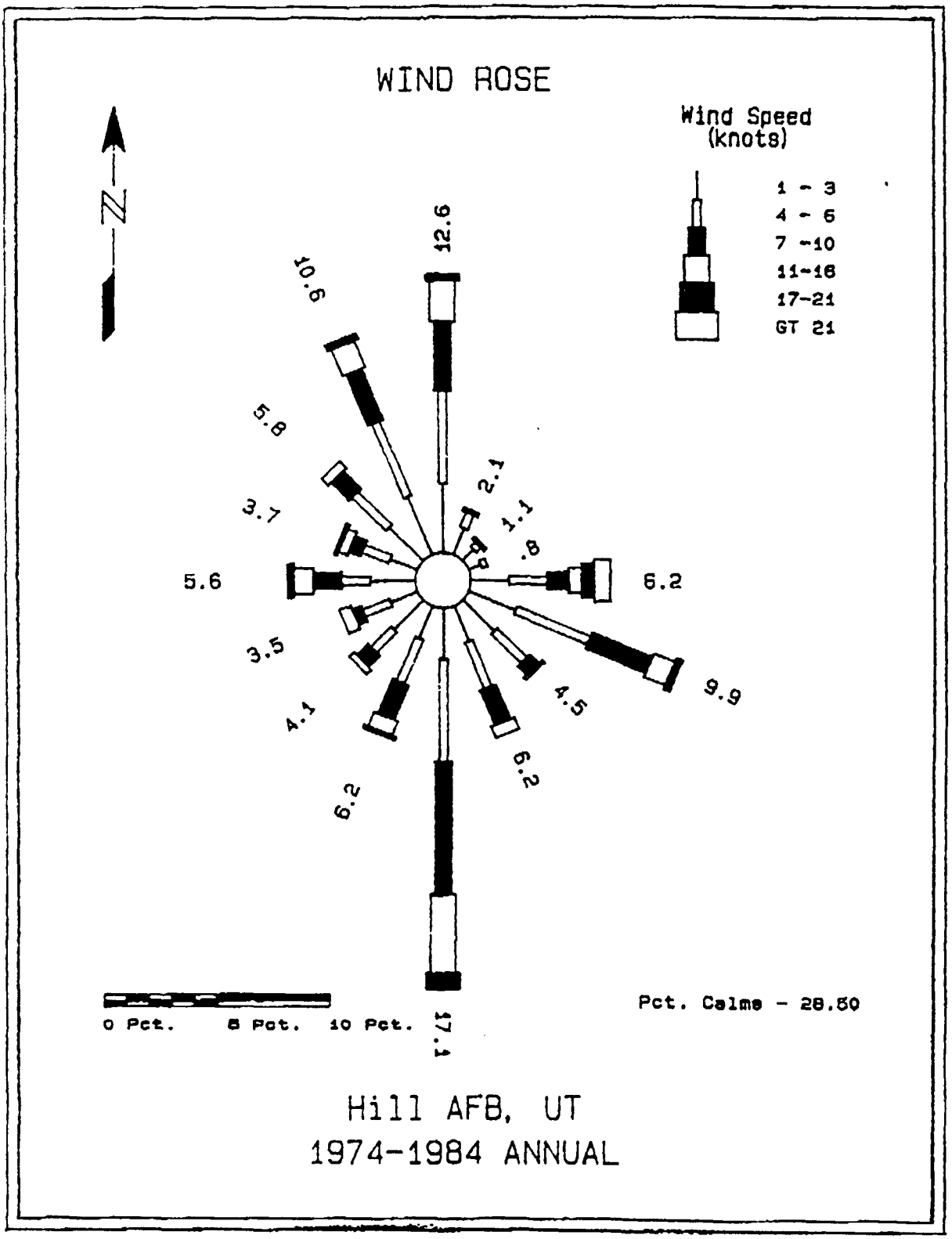
Ground Topography Near Bldg 1703 Waste Oil Boiler

Elevation Feet MSL

distance from stack (meters)	Bearing True Ø	9Ø	18Ø	27Ø
25	4605.5	4610	4605	4593.5
50	4605	4614	4604.5	4593
75	4605	4617.5	4604	4592.5
100	4605.5	4623	4604.5	4592
200	4607.5	4630.3	4606.5	4567
300	4604	4632.5	4605	4557
400	4594.5	4634	4603.5	4539
500	4603	4637	4601.5	4522

Elevation at base of stack 4603 ft MSL


WIND ROSE
Wind Speed
(knots)
1 - 3
4 - 6
7 -10
11-16
17-21
GT 21
N
12.6
10.6
5.8
3.7
2.1
1.1
.8
5.6
6.2
3.5
4.1
4.5
9.9
6.2
6.2
17.1
0 Pct.
5 Pct.
10 Pct.
Pct. Calms - 28.50
Hill AFB, UT
1974-1984 ANNUAL

SURFACE WINDS

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

74-78 YEARS | HILL AFB UT STATION NAME | ALL MONTH

INSTRUMENT CLASS | ALL HOURS (L.S.T.)

CIG 200 TO 1400 FT W/ VSBY 1/2 MI OR MORE, AND/OR VSBY 1/2 TO 2-1/2 MI W/CIG 200 FT OR MORE CONDITION

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	2.7	3.0	2.7	1.3	.2		.0					8.9	6.5
NNE	.9	.5	.1									1.6	3.9
NE	.5	.2	.1									.8	3.5
ENE	.4	.2		.0			.0	.0				.7	6.1
E	1.3	1.2	.7	.4	.4	.3	.0	.2				4.2	9.6
ESE	1.6	2.5	2.0	.7	.2	.0						7.1	6.5
SE	1.4	1.3	.4	.1								3.2	5.3
SSE	1.2	1.6	1.2	.4	.2		.0					4.5	6.0
S	1.6	3.3	4.2	2.5	.5	.0						12.2	6.1
SSW	1.1	1.5	1.2	.5	.1							4.3	6.4
SW	1.3	.9	.5	.2	.0	.0						3.0	5.5
WSW	.9	.9	.3	.4	.0							2.5	6.1
W	1.4	.9	.9	.6	.2	.0	.0					4.2	7.1
WNW	.9	.9	.4	.3	.1							2.5	5.8
NW	1.5	1.5	.9	.3		.0						4.2	5.7
NNW	2.7	2.6	1.9	.9	.2	.0						7.6	6.5
VARBL													
CALM												20.5	
	20.9	23.9	16.9	8.2	1.9	.4	.1	.2				100.1	6.7

TOTAL NUMBER OF OBSERVATIONS 9279

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APPENDIX D
PTPLU MODEL RUN

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1 PTPLU-2.0 (VERSION 86196)
AN AIR QUALITY DISPERSION MODEL IN
SECTION 3. NON-GUIDELINE MODELS.
IN UNAMAP (VERSION 6) JUL 86
SOURCE: UNAMAP FILE ON EPAS UNIVAC AT RTP, NC.

>>>INPUT PARAMETERS<<<

*** TITLE*** Hill AFB - Waste-Oil Boiler 100% (155 lbs oil/hr) - Barium

OPTIONS	***METEOROLOGY***		***SOURCE***	
IF = 1, USE OPTION	AMBIENT AIR TEMPERATURE =	286.00 (K)	EMISSION RATE =	.0003279 (G/SEC)
IF = 0, IGNORE OPTION	MIXING HEIGHT =	1500.00 (M)	STACK HEIGHT =	9.144 (M)
IOPT(1) = 0 (GRAD PLUME RISE)	ANEMOMETER HEIGHT =	10.00 (M)	EXIT TEMP. =	505.00 (K)
IOPT(2) = 1 (STACK DOWNWASH)	WIND PROFILE EXPONENTS =	A:0.07, B:0.07, C:0.10	EXIT VELOCITY =	4.80 (M/SEC)
IOPT(3) = 1 (BUOY. INDUCED DISP.)		D:0.15, E:0.35, F:0.55	STACK DIAM. =	0.711 (M)

IDFLT = 1 (1 = USE DEFAULT, 0 = NOT USE DEFAULT)
MUOR = 2(1 = URBAN, 2 = RURAL)
0***RECEPTOR HEIGHT*** = 1.80 (M)

>>>CALCULATED PARAMETERS<<<

VOLUMETRIC FLOW = 1.91 (M**3/SEC) BUOYANCY FLUX PARAMETER = 2.58 (M**4/SEC**3)

Hill AFB - Waste-Oil Boiler 100% (155 lbs oil/hr) - Barium

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
1	0.50	1.2763E-08	0.408	96.4	0.50	1.2731E-08	0.409	96.9
1	0.80	1.5830E-08	0.290	63.7	0.80	1.5784E-08	0.291	64.0
1	1.00	1.7491E-08	0.244	52.8	0.99	1.7438E-08	0.245	53.0
1	1.50	2.0821E-08	0.183	38.2	1.49	2.0772E-08	0.184	38.4
1	2.00	2.2889E-08	0.152	30.9	1.99	2.2848E-08	0.152	31.1
1	2.50	2.4211E-08	0.131	26.6	2.48	2.4179E-08	0.131	26.7
1	3.00	2.4970E-08	0.118	23.7	2.98	2.4950E-08	0.118	23.8

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
2	0.50	1.1083E-08	0.628	96.4	0.50	1.1037E-08	0.631	96.9
2	0.80	1.4747E-08	0.433	63.7	0.80	1.4696E-08	0.435	64.0
2	1.00	1.6781E-08	0.351	52.8	0.99	1.6720E-08	0.353	53.0
2	1.50	2.0698E-08	0.256	38.2	1.49	2.0640E-08	0.257	38.4
2	2.00	2.3218E-08	0.208	30.9	1.99	2.3168E-08	0.209	31.1
2	2.50	2.4967E-08	0.175	26.6	2.48	2.4922E-08	0.176	26.7
2	3.00	2.6102E-08	0.155	23.7	2.98	2.6069E-08	0.156	23.8
2	4.00	2.8355E-08	0.127	19.6	3.98	2.8307E-08	0.128	19.7
2	5.00	2.9773E-08	0.110	17.1	4.97	2.9741E-08	0.110	17.2

STABILITY	****WINDS CONSTANT WITH HEIGHT**** WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)**** WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
3	2.00	2.4512E-08	0.303	30.9	1.98	2.4424E-08	0.305	31.1
3	2.50	2.6520E-08	0.258	26.6	2.48	2.6447E-08	0.260	26.7
3	3.00	2.7827E-08	0.229	23.7	2.97	2.7771E-08	0.230	23.8
3	4.00	3.0408E-08	0.187	19.6	3.96	3.0329E-08	0.188	19.7
3	5.00	3.2069E-08	0.161	17.1	4.96	3.2015E-08	0.162	17.2
3	7.00	3.3244E-08	0.131	14.2	6.94	3.3236E-08	0.132	14.3
3	10.00	3.2539E-08	0.109	12.1	9.91	3.2581E-08	0.110	12.1
3	12.00	3.1440E-08	0.101	11.2	11.89	3.1506E-08	0.101	11.3
3	15.00	2.9533E-08	0.092	10.4	14.87	2.9620E-08	0.092	10.4

STABILITY	****WINDS CONSTANT WITH HEIGHT**** WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)**** WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
4	0.50	6.5578E-09	2.215	96.4	0.49	6.4578E-09	2.254	97.5
4	0.80	1.0934E-08	1.199	63.7	0.79	1.0784E-08	1.219	64.4
4	1.00	1.3555E-08	1.000	52.8	0.99	1.3409E-08	1.000	53.3
4	1.50	1.7786E-08	0.703	38.2	1.48	1.7644E-08	0.712	38.6
4	2.00	2.0771E-08	0.549	30.9	1.97	2.0637E-08	0.555	31.2
4	2.50	2.2865E-08	0.459	26.6	2.47	2.2748E-08	0.464	26.8
4	3.00	2.4313E-08	0.400	23.7	2.96	2.4217E-08	0.404	23.9
4	4.00	2.7173E-08	0.319	19.6	3.95	2.7039E-08	0.322	19.8
4	5.00	2.8977E-08	0.278	17.1	4.93	2.8892E-08	0.281	17.2
4	7.00	3.0306E-08	0.225	14.2	6.91	3.0284E-08	0.227	14.3
4	10.00	2.9909E-08	0.185	12.1	9.87	2.9957E-08	0.186	12.1
4	12.00	2.9007E-08	0.170	11.2	11.84	2.9088E-08	0.171	11.3
4	15.00	2.7359E-08	0.154	10.4	14.80	2.7473E-08	0.155	10.4
4	20.00	2.4569E-08	0.139	9.5	19.73	2.4712E-08	0.139	9.6

STABILITY	****WINDS CONSTANT WITH HEIGHT**** WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)**** WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
5	2.00	9.3896E-09	1.152	41.2	1.94	9.5019E-09	1.166	41.6
5	2.50	8.6158E-09	1.058	38.9	2.42	8.7216E-09	1.071	39.3
5	3.00	8.0163E-09	1.000	37.2	2.91	8.1179E-09	1.000	37.5
5	4.00	7.2684E-09	0.968	34.2	3.88	7.3470E-09	0.980	34.5
5	5.00	6.7138E-09	0.889	32.0	4.85	6.7910E-09	0.900	32.3

STABILITY	****WINDS CONSTANT WITH HEIGHT**** WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)**** WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
6	2.00	1.0589E-08	1.866	35.8	1.90	1.0804E-08	1.901	36.2
6	2.50	9.6520E-09	1.720	33.9	2.38	9.8533E-09	1.752	34.3
6	3.00	8.9315E-09	1.612	32.4	2.86	9.1221E-09	1.640	32.8
6	4.00	8.1701E-09	1.419	29.9	3.81	8.2857E-09	1.451	30.3
6	5.00	7.6371E-09	1.283	28.0	4.76	7.7556E-09	1.311	28.4

(1) THE DISTANCE TO THE POINT OF MAXIMUM CONCENTRATION IS SO GREAT THAT THE SAME STABILITY IS NOT LIKELY TO PERSIST LONG ENOUGH FOR THE PLUME TO TRAVEL THIS FAR.

(2) THE PLUME IS CALCULATED TO BE AT A HEIGHT WHERE CARE SHOULD BE USED IN INTERPRETING THE COMPUTATION.

(3) NO COMPUTATION WAS ATTEMPTED FOR THIS HEIGHT AS THE POINT OF MAXIMUM CONCENTRATION IS GREATER THAN 100 KILOMETERS FROM THE SOURCE.

>>>INPUT PARAMETERS<<<

*** TITLE*** Cadmium

OPTIONS	***METEOROLOGY***		***SOURCE***	
IF = 1, USE OPTION	AMBIENT AIR TEMPERATURE =	286.00 (K)	EMISSION RATE =	0.0004918 (G/SEC)
IF = 0, IGNORE OPTION	MIXING HEIGHT =	1500.00 (M)	STACK HEIGHT =	9.144 (M)
IOPT(1) = 0 (GRAD PLUME RISE)	ANEMOMETER HEIGHT =	10.00 (M)	EXIT TEMP. =	505.00 (K)
IOPT(2) = 1 (STACK DOWNWASH)	WIND PROFILE EXPONENTS =	A:0.07, B:0.07, C:0.10	EXIT VELOCITY =	4.80 (M/SEC)
IOPT(3) = 1 (BUOY. INDUCED DISP.)		D:0.15, E:0.35, F:0.55	STACK DIAM. =	0.711 (M)

IDFLT = 1 (1 = USE DEFAULT, 0 = NOT USE DEFAULT)

MUOR = 2(1 = URBAN, 2 = RURAL)

0***RECEPTOR HEIGHT*** = 1.80 (M)

>>>CALCULATED PARAMETERS<<<

VOLUMETRIC FLOW = 1.91 (M**3/SEC) BUOYANCY FLUX PARAMETER = 2.58 (M**4/SEC**3)

Cadmium

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
1	0.50	1.9143E-08	0.408	96.4	0.50	1.9095E-08	0.409	96.9
1	0.80	2.3743E-08	0.290	63.7	0.80	2.3673E-08	0.291	64.0
1	1.00	2.6234E-08	0.244	52.8	0.99	2.6155E-08	0.245	53.0
1	1.50	3.1229E-08	0.183	38.2	1.49	3.1154E-08	0.184	38.4
1	2.00	3.4329E-08	0.152	30.9	1.99	3.4269E-08	0.152	31.1
1	2.50	3.6313E-08	0.131	26.6	2.48	3.6264E-08	0.131	26.7
1	3.00	3.7451E-08	0.118	23.7	2.98	3.7421E-08	0.118	23.8

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
2	0.50	1.6622E-08	0.628	96.4	0.50	1.6554E-08	0.631	96.9
2	0.80	2.2119E-08	0.433	63.7	0.80	2.2041E-08	0.435	64.0
2	1.00	2.5169E-08	0.351	52.8	0.99	2.5078E-08	0.353	53.0
2	1.50	3.1044E-08	0.256	38.2	1.49	3.0956E-08	0.257	38.4
2	2.00	3.4824E-08	0.208	30.9	1.99	3.4749E-08	0.209	31.1
2	2.50	3.7446E-08	0.175	26.6	2.48	3.7379E-08	0.176	26.7
2	3.00	3.9149E-08	0.155	23.7	2.98	3.9099E-08	0.156	23.8
2	4.00	4.2527E-08	0.127	19.6	3.98	4.2456E-08	0.128	19.7
2	5.00	4.4655E-08	0.110	17.1	4.97	4.4606E-08	0.110	17.2

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
3	2.00	3.6764E-08	0.303	30.9	1.98	3.6632E-08	0.305	31.1
3	2.50	3.9776E-08	0.258	26.6	2.48	3.9667E-08	0.260	26.7
3	3.00	4.1736E-08	0.229	23.7	2.97	4.1652E-08	0.230	23.8
3	4.00	4.5607E-08	0.187	19.6	3.96	4.5489E-08	0.188	19.7
3	5.00	4.8099E-08	0.161	17.1	4.96	4.8018E-08	0.162	17.2
3	7.00	4.9860E-08	0.131	14.2	6.94	4.9848E-08	0.132	14.3
3	10.00	4.8804E-08	0.109	12.1	9.91	4.8866E-08	0.110	12.1
3	12.00	4.7156E-08	0.101	11.2	11.89	4.7254E-08	0.101	11.3
3	15.00	4.4294E-08	0.092	10.4	14.87	4.4425E-08	0.092	10.4

0	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
4	0.50	9.8357E-09	2.215	96.4	0.49	9.6858E-09	2.254	97.5
4	0.80	1.6400E-08	1.199	63.7	0.79	1.6175E-08	1.219	64.4
4	1.00	2.0331E-08	1.000	52.8	0.99	2.0111E-08	1.000	53.3
4	1.50	2.6676E-08	0.703	38.2	1.48	2.6463E-08	0.712	38.6
4	2.00	3.1153E-08	0.549	30.9	1.97	3.0952E-08	0.555	31.2
4	2.50	3.4294E-08	0.459	26.6	2.47	3.4119E-08	0.464	26.8
4	3.00	3.6466E-08	0.400	23.7	2.96	3.6321E-08	0.404	23.9
4	4.00	4.0756E-08	0.319	19.6	3.95	4.0554E-08	0.322	19.8
4	5.00	4.3461E-08	0.278	17.1	4.93	4.3334E-08	0.281	17.2
4	7.00	4.5455E-08	0.225	14.2	6.91	4.5421E-08	0.227	14.3
4	10.00	4.4858E-08	0.185	12.1	9.87	4.4931E-08	0.186	12.1
4	12.00	4.3506E-08	0.170	11.2	11.84	4.3628E-08	0.171	11.3
4	15.00	4.1034E-08	0.154	10.4	14.80	4.1205E-08	0.155	10.4
4	20.00	3.6850E-08	0.139	9.5	19.73	3.7064E-08	0.139	9.6

0	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
5	2.00	1.4083E-08	1.152	41.2	1.94	1.4251E-08	1.166	41.6
5	2.50	1.2922E-08	1.058	38.9	2.42	1.3081E-08	1.071	39.3
5	3.00	1.2023E-08	1.000	37.2	2.91	1.2176E-08	1.000	37.5
5	4.00	1.0902E-08	0.968	34.2	3.88	1.1019E-08	0.980	34.5
5	5.00	1.0070E-08	0.889	32.0	4.85	1.0185E-08	0.900	32.3

0	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
6	2.00	1.5882E-08	1.866	35.8	1.90	1.6204E-08	1.901	36.2
6	2.50	1.4476E-08	1.720	33.9	2.38	1.4778E-08	1.752	34.3
6	3.00	1.3396E-08	1.612	32.4	2.86	1.3682E-08	1.640	32.8
6	4.00	1.2254E-08	1.419	29.9	3.81	1.2427E-08	1.451	30.3
6	5.00	1.1454E-08	1.283	28.0	4.76	1.1632E-08	1.311	28.4

0 (1) THE DISTANCE TO THE POINT OF MAXIMUM CONCENTRATION IS SO GREAT THAT THE SAME STABILITY IS NOT LIKELY TO PERSIST LONG ENOUGH FOR THE PLUME TO TRAVEL THIS FAR.

0 (2) THE PLUME IS CALCULATED TO BE AT A HEIGHT WHERE CARE SHOULD BE USED IN INTERPRETING THE COMPUTATION.

0 (3) NO COMPUTATION WAS ATTEMPTED FOR THIS HEIGHT AS THE POINT OF MAXIMUM CONCENTRATION IS GREATER THAN 100 KILOMETERS FROM THE SOURCE.

>>>INPUT PARAMETERS<<<

*** TITLE*** Chromium

OPTIONS	***METEOROLOGY***		***SOURCE***	
IF = 1, USE OPTION	AMBIENT AIR TEMPERATURE =	286.00 (K)	EMISSION RATE =	0.0004288 (G/SEC)
IF = 0, IGNORE OPTION	MIXING HEIGHT =	1500.00 (M)	STACK HEIGHT =	9.144 (M)
IOPT(1) = 0 (GRAD PLUME RISE)	ANEMOMETER HEIGHT =	10.00 (M)	EXIT TEMP. =	505.00 (K)
IOPT(2) = 1 (STACK DOWNWASH)	WIND PROFILE EXPONENTS =	A:0.07, B:0.07, C:0.10	EXIT VELOCITY =	4.80 (M/SEC)
IOPT(3) = 1 (BUOY. INDUCED DISP.)		D:0.15, E:0.35, F:0.55	STACK DIAM. =	0.711 (M)

IDFLT = 1 (1 = USE DEFAULT, 0 = NOT USE DEFAULT)

MUOR = 2(1 = URBAN, 2 = RURAL)

0***RECEPTOR HEIGHT*** = 1.80 (M)

>>>CALCULATED PARAMETERS<<<

VOLUMETRIC FLOW = 1.91 (M**3/SEC) BUOYANCY FLUX PARAMETER = 2.58 (M**4/SEC**3)

Chromium

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
1	0.50	1.6690E-08	0.408	96.4	0.50	1.6648E-08	0.409	96.9
1	0.80	2.0701E-08	0.290	63.7	0.80	2.0641E-08	0.291	64.0
1	1.00	2.2873E-08	0.244	52.8	0.99	2.2804E-08	0.245	53.0
1	1.50	2.7228E-08	0.183	38.2	1.49	2.7163E-08	0.184	38.4
1	2.00	2.9932E-08	0.152	30.9	1.99	2.9879E-08	0.152	31.1
1	2.50	3.1661E-08	0.131	26.6	2.48	3.1619E-08	0.131	26.7
1	3.00	3.2654E-08	0.118	23.7	2.98	3.2627E-08	0.118	23.8

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
2	0.50	1.4493E-08	0.628	96.4	0.50	1.4434E-08	0.631	96.9
2	0.80	1.9285E-08	0.433	63.7	0.80	1.9218E-08	0.435	64.0
2	1.00	2.1945E-08	0.351	52.8	0.99	2.1865E-08	0.353	53.0
2	1.50	2.7067E-08	0.256	38.2	1.49	2.6991E-08	0.257	38.4
2	2.00	3.0363E-08	0.208	30.9	1.99	3.0297E-08	0.209	31.1
2	2.50	3.2649E-08	0.175	26.6	2.48	3.2591E-08	0.176	26.7
2	3.00	3.4134E-08	0.155	23.7	2.98	3.4090E-08	0.156	23.8
2	4.00	3.7080E-08	0.127	19.6	3.98	3.7018E-08	0.128	19.7
2	5.00	3.8935E-08	0.110	17.1	4.97	3.8892E-08	0.110	17.2

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
3	2.00	3.2054E-08	0.303	30.9	1.98	3.1939E-08	0.305	31.1
3	2.50	3.4681E-08	0.258	26.6	2.48	3.4586E-08	0.260	26.7
3	3.00	3.6389E-08	0.229	23.7	2.97	3.6316E-08	0.230	23.8
3	4.00	3.9765E-08	0.187	19.6	3.96	3.9662E-08	0.188	19.7
3	5.00	4.1938E-08	0.161	17.1	4.96	4.1867E-08	0.162	17.2
3	7.00	4.3473E-08	0.131	14.2	6.94	4.3463E-08	0.132	14.3
3	10.00	4.2552E-08	0.109	12.1	9.91	4.2606E-08	0.110	12.1
3	12.00	4.1115E-08	0.101	11.2	11.89	4.1201E-08	0.101	11.3
3	15.00	3.8620E-08	0.092	10.4	14.87	3.8734E-08	0.092	10.4

	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
4	0.50	8.5757E-09	2.215	96.4	0.49	8.4450E-09	2.254	97.5
4	0.80	1.4299E-08	1.199	63.7	0.79	1.4103E-08	1.219	64.4
4	1.00	1.7726E-08	1.000	52.8	0.99	1.7535E-08	1.000	53.3
4	1.50	2.3259E-08	0.703	38.2	1.48	2.3073E-08	0.712	38.6
4	2.00	2.7163E-08	0.549	30.9	1.97	2.6987E-08	0.555	31.2
4	2.50	2.9901E-08	0.459	26.6	2.47	2.9748E-08	0.464	26.8
4	3.00	3.1795E-08	0.400	23.7	2.96	3.1669E-08	0.404	23.9
4	4.00	3.5535E-08	0.319	19.6	3.95	3.5359E-08	0.322	19.8
4	5.00	3.7893E-08	0.278	17.1	4.93	3.7783E-08	0.281	17.2
4	7.00	3.9632E-08	0.225	14.2	6.91	3.9603E-08	0.227	14.3
4	10.00	3.9112E-08	0.185	12.1	9.87	3.9175E-08	0.186	12.1
4	12.00	3.7933E-08	0.170	11.2	11.84	3.8039E-08	0.171	11.3
4	15.00	3.5777E-08	0.154	10.4	14.80	3.5926E-08	0.155	10.4
4	20.00	3.2130E-08	0.139	9.5	19.73	3.2316E-08	0.139	9.6

	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
5	2.00	1.2279E-08	1.152	41.2	1.94	1.2426E-08	1.166	41.6
5	2.50	1.1267E-08	1.058	38.9	2.42	1.1405E-08	1.071	39.3
5	3.00	1.0483E-08	1.000	37.2	2.91	1.0616E-08	1.000	37.5
5	4.00	9.5050E-09	0.968	34.2	3.88	9.6078E-09	0.980	34.5
5	5.00	8.7798E-09	0.889	32.0	4.85	8.8807E-09	0.900	32.3

	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
6	2.00	1.3847E-08	1.866	35.8	1.90	1.4128E-08	1.901	36.2
6	2.50	1.2622E-08	1.720	33.9	2.38	1.2885E-08	1.752	34.3
6	3.00	1.1680E-08	1.612	32.4	2.86	1.1929E-08	1.640	32.8
6	4.00	1.0684E-08	1.419	29.9	3.81	1.0835E-08	1.451	30.3
6	5.00	9.9872E-09	1.283	28.0	4.76	1.0142E-08	1.311	28.4

(1) THE DISTANCE TO THE POINT OF MAXIMUM CONCENTRATION IS SO GREAT THAT THE SAME STABILITY IS NOT LIKELY TO PERSIST LONG ENOUGH FOR THE PLUME TO TRAVEL THIS FAR.

(2) THE PLUME IS CALCULATED TO BE AT A HEIGHT WHERE CARE SHOULD BE USED IN INTERPRETING THE COMPUTATION.

(3) NO COMPUTATION WAS ATTEMPTED FOR THIS HEIGHT AS THE POINT OF MAXIMUM CONCENTRATION IS GREATER THAN 100 KILOMETERS FROM THE SOURCE.

>>>INPUT PARAMETERS<<<

*** TITLE*** Lead

OPTIONS	***METEOROLOGY***		***SOURCE***	
IF = 1, USE OPTION	AMBIENT AIR TEMPERATURE =	286.00 (K)	EMISSION RATE =	0.014 (G/SEC)
IF = 0, IGNORE OPTION	MIXING HEIGHT =	1500.00 (M)	STACK HEIGHT =	9.144 (M)
IOPT(1) = 0 (GRAD PLUME RISE)	ANEMOMETER HEIGHT =	10.00 (M)	EXIT TEMP. =	505.00 (K)
IOPT(2) = 1 (STACK DOWNWASH)	WIND PROFILE EXPONENTS =	A:0.07, B:0.07, C:0.10	EXIT VELOCITY =	4.80 (M/SEC)
IOPT(3) = 1 (BUOY. INDUCED DISP.)		D:0.15, E:0.35, F:0.55	STACK DIAM. =	0.711 (M)

IDFLT = 1 (1 = USE DEFAULT, 0 = NOT USE DEFAULT)

MUOR = 2(1 = URBAN, 2 = RURAL)

0***RECEPTOR HEIGHT*** = 1.80 (M)

>>>CALCULATED PARAMETERS<<<

VOLUMETRIC FLOW = 1.91 (M**3/SEC) BUOYANCY FLUX PARAMETER = 2.58 (M**4/SEC**3)

Lead

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
1	0.50	5.4493E-07	0.408	96.4	0.50	5.4356E-07	0.409	96.9
1	0.80	6.7588E-07	0.290	63.7	0.80	6.7390E-07	0.291	64.0
1	1.00	7.4680E-07	0.244	52.8	0.99	7.4454E-07	0.245	53.0
1	1.50	8.8898E-07	0.183	38.2	1.49	8.8686E-07	0.184	38.4
1	2.00	9.7725E-07	0.152	30.9	1.99	9.7554E-07	0.152	31.1
1	2.50	1.0337E-06	0.131	26.6	2.48	1.0323E-06	0.131	26.7
1	3.00	1.0661E-06	0.118	23.7	2.98	1.0652E-06	0.118	23.8

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
2	0.50	4.7318E-07	0.628	96.4	0.50	4.7125E-07	0.631	96.9
2	0.80	6.2965E-07	0.433	63.7	0.80	6.2744E-07	0.435	64.0
2	1.00	7.1648E-07	0.351	52.8	0.99	7.1389E-07	0.353	53.0
2	1.50	8.8373E-07	0.256	38.2	1.49	8.8123E-07	0.257	38.4
2	2.00	9.9133E-07	0.208	30.9	1.99	9.8918E-07	0.209	31.1
2	2.50	1.0660E-06	0.175	26.6	2.48	1.0641E-06	0.176	26.7
2	3.00	1.1144E-06	0.155	23.7	2.98	1.1130E-06	0.156	23.8
2	4.00	1.2106E-06	0.127	19.6	3.98	1.2086E-06	0.128	19.7
2	5.00	1.2712E-06	0.110	17.1	4.97	1.2698E-06	0.110	17.2

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
3	2.00	1.0466E-06	0.303	30.9	1.98	1.0428E-06	0.305	31.1
3	2.50	1.1323E-06	0.258	26.6	2.48	1.1292E-06	0.260	26.7
3	3.00	1.1881E-06	0.229	23.7	2.97	1.1857E-06	0.230	23.8
3	4.00	1.2983E-06	0.187	19.6	3.96	1.2949E-06	0.188	19.7
3	5.00	1.3692E-06	0.161	17.1	4.96	1.3669E-06	0.162	17.2
3	7.00	1.4194E-06	0.131	14.2	6.94	1.4190E-06	0.132	14.3
3	10.00	1.3893E-06	0.109	12.1	9.91	1.3911E-06	0.110	12.1
3	12.00	1.3424E-06	0.101	11.2	11.89	1.3452E-06	0.101	11.3
3	15.00	1.2609E-06	0.092	10.4	14.87	1.2646E-06	0.092	10.4

STABILITY	****WINDS CONSTANT WITH HEIGHT**** WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)**** WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
4	0.50	2.7999E-07	2.215	96.4	0.49	2.7572E-07	2.254	97.5
4	0.80	4.6685E-07	1.199	63.7	0.79	4.6045E-07	1.219	64.4
4	1.00	5.7876E-07	1.000	52.8	0.99	5.7251E-07	1.000	53.3
4	1.50	7.5939E-07	0.703	38.2	1.48	7.5331E-07	0.712	38.6
4	2.00	8.8684E-07	0.549	30.9	1.97	8.8112E-07	0.555	31.2
4	2.50	9.7625E-07	0.459	26.6	2.47	9.7125E-07	0.464	26.8
4	3.00	1.0381E-06	0.400	23.7	2.96	1.0340E-06	0.404	23.9
4	4.00	1.1602E-06	0.319	19.6	3.95	1.1544E-06	0.322	19.8
4	5.00	1.2372E-06	0.278	17.1	4.93	1.2336E-06	0.281	17.2
4	7.00	1.2939E-06	0.225	14.2	6.91	1.2930E-06	0.227	14.3
4	10.00	1.2770E-06	0.185	12.1	9.87	1.2790E-06	0 186	12.1
4	12.00	1.2385E-06	0.170	11.2	11.84	1.2419E-06	0.171	11.3
4	15.00	1.1681E-06	0.154	10.4	14.80	1.1730E-06	0.155	10.4
4	20.00	1.0490E-06	0.139	9.5	19.73	1.0551E-06	0.139	9.6

STABILITY	****WINDS CONSTANT WITH HEIGHT**** WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)**** WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
5	2.00	4.0090E-07	1.152	41.2	1.94	4.0569E-07	1.166	41.6
5	2.50	3.6786E-07	1.058	38.9	2.42	3.7238E-07	1.071	39.3
5	3.00	3.4226E-07	1.000	37.2	2.91	3.4660E-07	1.000	37.5
5	4.00	3.1033E-07	0.968	34.2	3.88	3.1369E-07	0.980	34.5
5	5.00	2.8665E-07	0.889	32.0	4.85	2.8995E-07	0.900	32.3

STABILITY	****WINDS CONSTANT WITH HEIGHT**** WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)**** WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
6	2.00	4.5210E-07	1.866	35.8	1.90	4.6127E-07	1.901	36.2
6	2.50	4.1210E-07	1.720	33.9	2.38	4.2070E-07	1.752	34.3
6	3.00	3.8134E-07	1.612	32.4	2.86	3.8948E-07	1.640	32.8
6	4.00	3.4883E-07	1.419	29.9	3.81	3.5377E-07	1.451	30.3
6	5.00	3.2607E-07	1.283	28.0	4.76	3.3113E-07	1.311	28.4

(1) THE DISTANCE TO THE POINT OF MAXIMUM CONCENTRATION IS SO GREAT THAT THE SAME STABILITY IS NOT LIKELY TO PERSIST LONG ENOUGH FOR THE PLUME TO TRAVEL THIS FAR.

(2) THE PLUME IS CALCULATED TO BE AT A HEIGHT WHERE CARE SHOULD BE USED IN INTERPRETING THE COMPUTATION.

(3) NO COMPUTATION WAS ATTEMPTED FOR THIS HEIGHT AS THE POINT OF MAXIMUM CONCENTRATION IS GREATER THAN 100 KILOMETERS FROM THE SOURCE.

>>>INPUT PARAMETERS<<<

*** TITLE*** Total particulates

OPTIONS	***METEOROLOGY***		***SOURCE***	
IF = 1, USE OPTION	AMBIENT AIR TEMPERATURE =	286.00 (K)	EMISSION RATE =	2.054 (G/SEC)
IF = 0, IGNORE OPTION	MIXING HEIGHT =	1500.00 (M)	STACK HEIGHT =	9.144 (M)
IOPT(1) = 0 (GRAD PLUME RISE)	ANEMOMETER HEIGHT =	10.00 (M)	EXIT TEMP. =	505.00 (K)
IOPT(2) = 1 (STACK DOWNWASH)	WIND PROFILE EXPONENTS =	A:0.07, B:0.07, C:0.10	EXIT VELOCITY =	4.80 (M/SEC)
IOPT(3) = 1 (BUOY. INDUCED DISP.)		D:0.15, E:0.35, F:0.55	STACK DIAM. =	0.711 (M)

IDFLT = 1 (1 = USE DEFAULT, 0 = NOT USE DEFAULT)

MUOR = 2(1 = URBAN, 2 = RURAL)

0***RECEPTOR HEIGHT*** = 1.80 (M)

>>>CALCULATED PARAMETERS<<<

VOLUMETRIC FLOW = 1.91 (M**3/SEC) BUOYANCY FLUX PARAMETER = 2.58 (M**4/SEC**3)

Total particulates

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
1	0.50	7.9949E-05	0.408	96.4	0.50	7.9748E-05	0.409	96.9
1	0.80	9.9162E-05	0.290	63.7	0.80	9.8870E-05	0.291	64.0
1	1.00	1.0957E-04	0.244	52.8	0.99	1.0924E-04	0.245	53.0
1	1.50	1.3043E-04	0.183	38.2	1.49	1.3012E-04	0.184	38.4
1	2.00	1.4338E-04	0.152	30.9	1.99	1.4313E-04	0.152	31.1
1	2.50	1.5166E-04	0.131	26.6	2.48	1.5146E-04	0.131	26.7
1	3.00	1.5642E-04	0.118	23.7	2.98	1.5629E-04	0.118	23.8

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
2	0.50	6.9422E-05	0.628	96.4	0.50	6.9140E-05	0.631	96.9
2	0.80	9.2378E-05	0.433	63.7	0.80	9.2054E-05	0.435	64.0
2	1.00	1.0512E-04	0.351	52.8	0.99	1.0474E-04	0.353	53.0
2	1.50	1.2966E-04	0.256	38.2	1.49	1.2929E-04	0.257	38.4
2	2.00	1.4544E-04	0.208	30.9	1.99	1.4513E-04	0.209	31.1
2	2.50	1.5639E-04	0.175	26.6	2.48	1.5611E-04	0.176	26.7
2	3.00	1.6351E-04	0.155	23.7	2.98	1.6330E-04	0.156	23.8
2	4.00	1.7762E-04	0.127	19.6	3.98	1.7732E-04	0.128	19.7
2	5.00	1.8650E-04	0.110	17.1	4.97	1.8630E-04	0.110	17.2

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
3	2.00	1.5354E-04	0.303	30.9	1.98	1.5299E-04	0.305	31.1
3	2.50	1.6612E-04	0.258	26.6	2.48	1.6567E-04	0.260	26.7
3	3.00	1.7431E-04	0.229	23.7	2.97	1.7396E-04	0.230	23.8
3	4.00	1.9048E-04	0.187	19.6	3.96	1.8998E-04	0.188	19.7
3	5.00	2.0089E-04	0.161	17.1	4.96	2.0055E-04	0.162	17.2
3	7.00	2.0824E-04	0.131	14.2	6.94	2.0819E-04	0.132	14.3
3	10.00	2.0383E-04	0.109	12.1	9.91	2.0409E-04	0.110	12.1
3	12.00	1.9695E-04	0.101	11.2	11.89	1.9736E-04	0.101	11.3
3	15.00	1.8500E-04	0.092	10.4	14.87	1.8554E-04	0.092	10.4

	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
4	0.50	4.1079E-05	2.215	96.4	0.49	4.0453E-05	2.254	97.5
4	0.80	6.8493E-05	1.199	63.7	0.79	6.7555E-05	1.219	64.4
4	1.00	8.4912E-05	1.000	52.8	0.99	8.3995E-05	1.000	53.3
4	1.50	1.1141E-04	0.703	38.2	1.48	1.1052E-04	0.712	38.6
4	2.00	1.3011E-04	0.549	30.9	1.97	1.2927E-04	0.555	31.2
4	2.50	1.4323E-04	0.459	26.6	2.47	1.4250E-04	0.464	26.8
4	3.00	1.5230E-04	0.400	23.7	2.96	1.5170E-04	0.404	23.9
4	4.00	1.7022E-04	0.319	19.6	3.95	1.6937E-04	0.322	19.8
4	5.00	1.8151E-04	0.278	17.1	4.93	1.8098E-04	0.281	17.2
4	7.00	1.8984E-04	0.225	14.2	6.91	1.8970E-04	0.227	14.3
4	10.00	1.8735E-04	0.185	12.1	9.87	1.8765E-04	0.186	12.1
4	12.00	1.8170E-04	0.170	11.2	11.84	1.8221E-04	0.171	11.3
4	15.00	1.7138E-04	0.154	10.4	14.80	1.7209E-04	0.155	10.4
4	20.00	1.5390E-04	0.139	9.5	19.73	1.5480E-04	0.139	9.6
	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
5	2.00	5.8817E-05	1.152	41.2	1.94	5.9521E-05	1.166	41.6
5	2.50	5.3970E-05	1.058	38.9	2.42	5.4633E-05	1.071	39.3
5	3.00	5.0215E-05	1.000	37.2	2.91	5.0851E-05	1.000	37.5
5	4.00	4.5530E-05	0.968	34.2	3.88	4.6022E-05	0.980	34.5
5	5.00	4.2056E-05	0.889	32.0	4.85	4.2540E-05	0.900	32.3
	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
6	2.00	6.6329E-05	1.866	35.8	1.90	6.7676E-05	1.901	36.2
6	2.50	6.0461E-05	1.720	33.9	2.38	6.1722E-05	1.752	34.3
6	3.00	5.5948E-05	1.612	32.4	2.86	5.7142E-05	1.640	32.8
6	4.00	5.1178E-05	1.419	29.9	3.81	5.1903E-05	1.451	30.3
6	5.00	4.7840E-05	1.283	28.0	4.76	4.8582E-05	1.311	28.4

(1) THE DISTANCE TO THE POINT OF MAXIMUM CONCENTRATION IS SO GREAT THAT THE SAME STABILITY IS NOT LIKELY TO PERSIST LONG ENOUGH FOR THE PLUME TO TRAVEL THIS FAR.

(2) THE PLUME IS CALCULATED TO BE AT A HEIGHT WHERE CARE SHOULD BE USED IN INTERPRETING THE COMPUTATION.

(3) NO COMPUTATION WAS ATTEMPTED FOR THIS HEIGHT AS THE POINT OF MAXIMUM CONCENTRATION IS GREATER THAN 100 KILOMETERS FROM THE SOURCE.

>>>INPUT PARAMETERS<<<

*** TITLE*** Sulfur Dioxide (.5% sulfur by wt)

OPTIONS	***METEOROLOGY***		***SOURCE***	
IF = 1, USE OPTION	AMBIENT AIR TEMPERATURE =	286.00 (K)	EMISSION RATE =	0.683 (G/SEC)
IF = 0, IGNORE OPTION	MIXING HEIGHT =	1500.00 (M)	STACK HEIGHT =	9.144 (M)
IOPT(1) = 0 (GRAD PLUME RISE)	ANEMOMETER HEIGHT =	10.00 (M)	EXIT TEMP. =	505.00 (K)
IOPT(2) = 1 (STACK DOWNWASH)	WIND PROFILE EXPONENTS =	A:0.07, B:0.07, C:0.10	EXIT VELOCITY =	4.80 (M/SEC)
IOPT(3) = 1 (BUOY. INDUCED DISP.)		D:0.15, E:0.35, F:0.55	STACK DIAM. =	0.711 (M)

IDFLT = 1 (1 = USE DEFAULT, 0 = NOT USE DEFAULT)

MUOR = 2(1 = URBAN, 2 = RURAL)

0***RECEPTOR HEIGHT*** = 1.80 (M)

>>>CALCULATED PARAMETERS<<<

VOLUMETRIC FLOW = 1.91 (M**3/SEC) BUOYANCY FLUX PARAMETER = 2.58 (M**4/SEC**3)

Sulfur Dioxide (.5% sulfur by wt)

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
1	0.50	2.6585E-05	0.408	96.4	0.50	2.6518E-05	0.409	96.9
1	0.80	3.2973E-05	0.290	63.7	0.80	3.2877E-05	0.291	64.0
1	1.00	3.6433E-05	0.244	52.8	0.99	3.6323E-05	0.245	53.0
1	1.50	4.336 E-05	0.183	38.2	1.49	4.3266E-05	0.184	38.4
1	2.00	4.7576E-05	0.152	30.9	1.99	4.7592E-05	0.152	31.1
1	2.50	5.0430E-05	0.131	26.6	2.48	5.0363E-05	0.131	26.7
1	3.00	5.2012E-05	0.118	23.7	2.98	5.1969E-05	0.118	23.8

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
2	0.50	2.3084E-05	0.628	96.4	0.50	2.2990E-05	0.631	96.9
2	0.80	3.0718E-05	0.433	63.7	0.80	3.0610E-05	0.435	64.0
2	1.00	3.4954E-05	0.351	52.8	0.99	3.4828E-05	0.353	53.0
2	1.50	4.3113E-05	0.256	38.2	1.49	4.2991E-05	0.257	38.4
2	2.00	4.8363E-05	0.208	30.9	1.99	4.8258E-05	0.209	31.1
2	2.50	5.2004E-05	0.175	26.6	2.48	5.1911E-05	0.176	26.7
2	3.00	5.4369E-05	0.155	23.7	2.98	5.4300E-05	0.156	23.8
2	4.00	5.9061E-05	0.127	19.6	3.98	5.8962E-05	0.128	19.7
2	5.00	6.2016E-05	0.110	17.1	4.97	6.1948E-05	0.110	17.2

0 ****WINDS CONSTANT WITH HEIGHT**** ****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****

STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
3	2.00	5.1057E-05	0.303	30.9	1.98	5.0874E-05	0.305	31.1
3	2.50	5.5240E-05	0.258	26.6	2.48	5.5089E-05	0.260	26.7
3	3.00	5.7961E-05	0.229	23.7	2.97	5.7845E-05	0.230	23.8
3	4.00	6.3338E-05	0.187	19.6	3.96	6.3174E-05	0.188	19.7
3	5.00	6.6799E-05	0.161	17.1	4.96	6.6686E-05	0.162	17.2
3	7.00	6.9245E-05	0.131	14.2	6.94	6.9228E-05	0.132	14.3
3	10.00	6.7778E-05	0.109	12.1	9.91	6.7864E-05	0.110	12.1
3	12.00	6.5489E-05	0.101	11.2	11.89	6.5625E-05	0.101	11.3
3	15.00	6.1515E-05	0.092	10.4	14.87	6.1696E-05	0.092	10.4

0	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
4	0.50	1.3660E-05	2.215	96.4	0.49	1.3451E-05	2.254	97.5
4	0.80	2.2776E-05	1.199	63.7	0.79	2.2463E-05	1.219	64.4
4	1.00	2.8235E-05	1.000	52.8	0.99	2.7930E-05	1.000	53.3
4	1.50	3.7047E-05	0.703	38.2	1.48	3.6751E-05	0.712	38.6
4	2.00	4.3265E-05	0.549	30.9	1.97	4.2986E-05	0.555	31.2
4	2.50	4.7627E-05	0.459	26.6	2.47	4.7383E-05	0.464	26.8
4	3.00	5.0643E-05	0.400	23.7	2.96	5.0442E-05	0.404	23.9
4	4.00	5.6601E-05	0.319	19.6	3.95	5.6320E-05	0.322	19.8
4	5.00	6.0357E-05	0.278	17.1	4.93	6.0181E-05	0.281	17.2
4	7.00	6.3126E-05	0.225	14.2	6.91	6.3080E-05	0.227	14.3
4	10.00	6.2298E-05	0.185	12.1	9.87	6.2399E-05	0.186	12.1
4	12.00	6.0420E-05	0.170	11.2	11.84	6.0589E-05	0.171	11.3
4	15.00	5.6987E-05	0.154	10.4	14.80	5.7224E-05	0.155	10.4
4	20.00	5.1177E-05	0.139	9.5	19.73	5.1474E-05	0.139	9.6

0	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
5	2.00	1.9558E-05	1.152	41.2	1.94	1.9792E-05	1.166	41.6
5	2.50	1.7946E-05	1.058	38.9	2.42	1.8167E-05	1.071	39.3
5	3.00	1.6698E-05	1.000	37.2	2.91	1.6909E-05	1.000	37.5
5	4.00	1.5140E-05	0.968	34.2	3.88	1.5303E-05	0.980	34.5
5	5.00	1.3985E-05	0.889	32.0	4.85	1.4145E-05	0.900	32.3

0	****WINDS CONSTANT WITH HEIGHT****				****STACK TOP WINDS (EXTRAPOLATED FROM 10.0 METERS)****			
STABILITY	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)	WIND SPEED (M/SEC)	MAX CONC (G/CU M)	DIST OF MAX (KM)	PLUME HT (M)
6	2.00	2.2056E-05	1.866	35.8	1.90	2.2504E-05	1.901	36.2
6	2.50	2.0105E-05	1.720	33.9	2.38	2.0524E-05	1.752	34.3
6	3.00	1.8604E-05	1.612	32.4	2.86	1.9001E-05	1.640	32.8
6	4.00	1.7018E-05	1.419	29.9	3.81	1.7259E-05	1.451	30.3
6	5.00	1.5908E-05	1.283	28.0	4.76	1.6155E-05	1.311	28.4

0 (1) THE DISTANCE TO THE POINT OF MAXIMUM CONCENTRATION IS SO GREAT THAT THE SAME STABILITY IS NOT LIKELY TO PERSIST LONG ENOUGH FOR THE PLUME TO TRAVEL THIS FAR.

0 (2) THE PLUME IS CALCULATED TO BE AT A HEIGHT WHERE CARE SHOULD BE USED IN INTERPRETING THE COMPUTATION.

0 (3) NO COMPUTATION WAS ATTEMPTED FOR THIS HEIGHT AS THE POINT OF MAXIMUM CONCENTRATION IS GREATER THAN 100 KILOMETERS FROM THE SOURCE.

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